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Modification of Shaper Machine with the Replacement of Tool Holder

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Abstract: ***Nowadays, machine tool builders can no longer have enough money to consume time and money building and testing real prototypes of the machine tool model, instead they use virtual prototypes. Shaper machine has received limited attention regarding their dynamic and static behavior. Shaper machine was remodeled for more static, kinematic and dynamic analyses. This paper presents the current state of virtual prototyping of a shaper machine tool; the work focuses on the design of the machine tool structure, main gear box, and tool shank and tool holder systems.***
Shaper machine produced by the Egyptian Machine Tool Factory is selected for this study. The structural behavior under static and dynamic loads is evaluated in order to obtain an optimized design of the shaper machine elements. Several software like Autodesk, CREO, ANSYS and Solid works has been used for remodeling and analysis. Kinematic analysis defined position of shaper quick return mechanisms links, motion of ram, end of the rocker and machine crank as well as the displacement, velocity and acceleration of machine ram or cutting tool for different values of crank length and number of strokes per minutes. Finite element analyses of machine parts in static and modal domains are carried out on machine parts and their sub-assemblies. Using Virtual Prototyping techniques, engineers are able to shorten the design time and therefore shorten the time needed for pushing to market new products
Keywords: Deformation; Equation of motion; Mechanism; Modified tool holder; Static analysis

I. INTRODUCTION

Shaper is a machine tool which produces flat surfaces in horizontal, vertical or inclined planes depending upon the orientation of the cutting tool. Shapers were very common in industrial production. The shaping machine is used to machine flat metal surfaces especially where a large amount of metal has to be removed. Other machines such as milling machines are much more expensive and are more suited to removing smaller amounts of metal, very accurately. Material used for this shaper machine whole body made up of cast iron and tool holder material is made up of high speed tool steel. The reciprocating motion of the mechanism inside the shaping machine is obtained by using quick return mechanism. The gear box last driven gear is used as a rotating disk. As the disc rotates the top of the machine, “ram” moves forwards and backwards, pushing a cutting tool Quick-return mechanism design and static analysis has received a lot of attention The links displacement, velocity were found. Computer-Aided Design of shaper machine tool holder will be modify to place three tool and work. In the quick return mechanism, the velocity of cutting stroke and return stroke both change with the change in length of slotted link but the total velocity ratio remains constant. The velocity ratio and force output changes with the change in height of slider. In metal cutting, a cutting tool is used to remove excess material from a work piece in order to convert the remaining material into the desired part shape. Proper selection of tool materials, cutting parameters, and tool geometry and machine tools is essential to produce high-quality products at low cost. Therefore, many attempts have been made to reduce cost and improve quality through the understanding of the cutting process. Cutting force calculations failed to produce accurate results and therefore experimental measurement of the cutting forces became unavoidable. In the literature, there are many studies concerning the cutting force measurement. Many dynamometers have been developed for this purpose. In this study, in order to investigate the effect of speed ,feed ,depth of cut ,tool shape, tool material, tool geometry on the main cutting force (Fp) and thrust force (Ft) during the machining with linear motion a test setup has been designed and manufactured . Beam type load cells were used in this setup and the cutting force values were recorded automatically on a computer during the tests. In the measurement of cutting forces experimentally it was aimed to determine the deflection of the cutting tool due to the cutting force by means of load cells located in suitable positions on the cutting tool. Data have been analyzed by using ANSYS R-15.0 software and draw the main effect plots, interaction plots between parameter. A single point cutting tool has only one cutting edge or point. It consists of a sharpened cutting part called its point and shank. A single point cutting tool used for turning, boring, shaping and planning operations, that is, tool used on the lathes, boring machines, shaper, planner etc. are single

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point cutting tool .in this modified tool holder of a shaper machine we have attached three tools linearly in order to increase the productivity of conventional shaper machine and therefore time required for specified work will be less.

II. METHODOLOGY

A. *Study of Shaper Machine*

The conventional shaper machine used to produce keyway slots on a work piece In conventional shaper machine single point cutting tool is used the material of this cutting of this cutting tool is HIGH SPEED STEEL this cutting tool is mounted or fixed on a tool holder the tool holder is connected to ram of shaper machine

B. *Problem Identification*

The shaper achine performs only one operation and it require more time to complete one job with one cutting tool.
The machine requires more time to complete a job in single cutting stroke while having return stroke idle. Hence there is a need of designing a new tool holder attachment which shall increase productivity is necessitated. Therefore the new tool holder is to be designed in such a way that it can be able to hold and operate three tools at a same time.
While attaching the three tools on a front side of tool holder there is a need of enlarging the existing size of tool holder so that three tools can be easily fitted into enlarging tool holder.

C. *Selection of Dimension of 12 Inch Conventional Shaper Machine*

1) Length of ram stroke = 12 inches (305 mm)
2) Length of ram = 26 inches (660 mm)
3) Length of width of ram bearing = 26*7 inches (660*178 mm)
4) Maximum and minimum distance = 10*1 inches
5) Working surface of table = 12*8 inches (305*228 mm)
6) Maximum table travel =16 ½ inches
7) Angular movement = 60L and 60R
8) Maximum vertical travel of tool side = 5 inches (140mm)
9) Maximum swivel of tool head = 60L and 60R
10) Length of width of base = 37*18 inches (940*457 mm)
11) Range of tool head feed = 0.009 inches (0.229 mm
12) Electrical specification
13) Electric motor 1.5 HP to 2 HP
14) Drive motor 1440 r.p.
15) Main switch starter (push button type) 3.5 amp

D. *Design of Prototype*

The designing of prototype is done with the help of solid works software in which design of cad modeling of modified shaper machine with replacement of tool holder is design. According to that cad model the fabrication of prototype of a modified shaper machine is done. In this prototype modification is done on tool holder so that the tool holder can able to hold and carry three cutting tool at a same time.

E. *ANSYS*

ANSYS is a general purpose software, used to simulate interactions of all disciplines of physics, structural, vibration, fluid dynamics, heat transfer and electromagnetic for engineers. ANSYS can work integrated with other used engineering software on desktop by adding CAD and FEA connection modules.

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III. RESULT AND DISCUSSION

A. *Proposed Work*

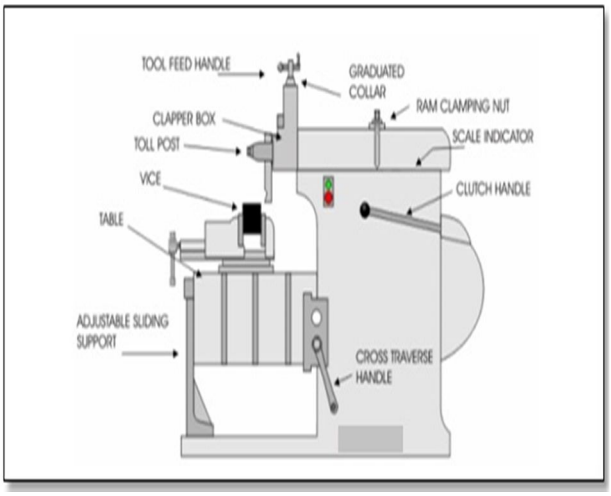

Figure 1: Conventional Shaper Machine

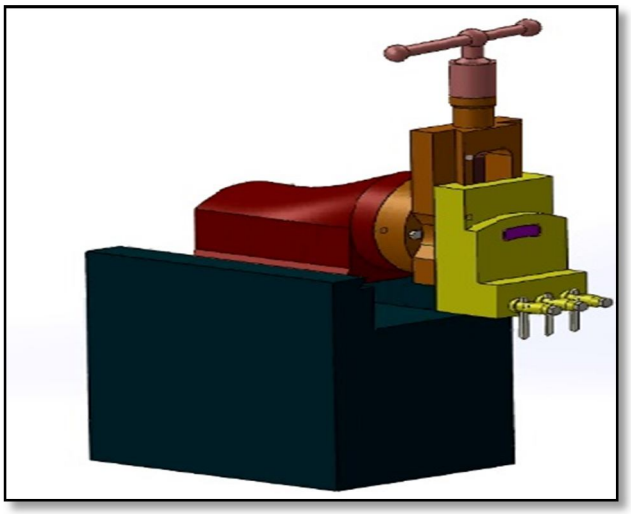

Figure 2: Actual diagram

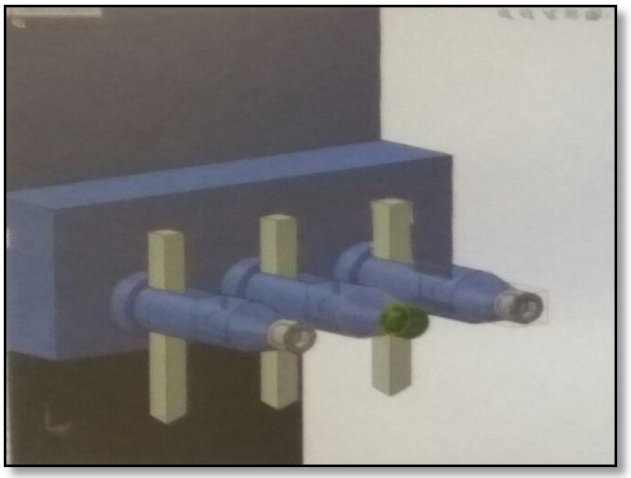

Figure: 3 Modified tool holder

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B. Analysis of Tool Holder

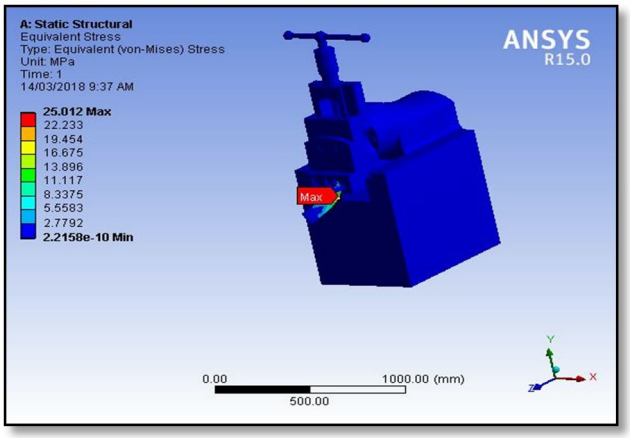

Figure: 4 Equivalent stress

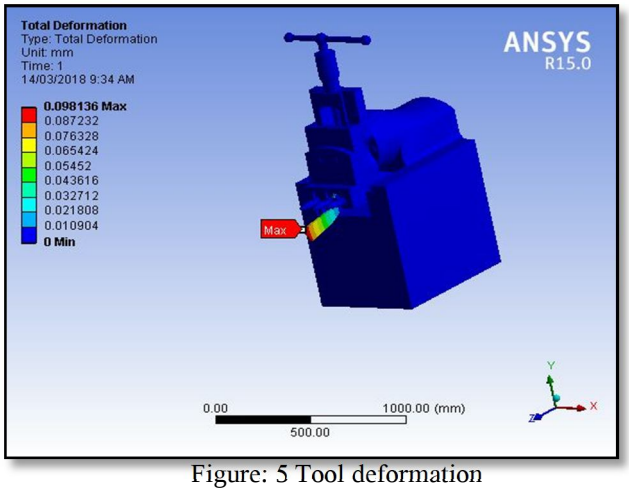

Figure: 5 Tool deformation

Our project is used in tool material is high speed tool. This tool is used in most commonly to the machining operation like milling, shaper, lathe for cutting operation. High speed steel is high performance special steel offering high hardness and sustain at temperature up to 500^{o}C and high layer resistance.

Normal load is used in our project is 1168N for 3mm depth of cut and to find out stress that is maximum stress for 3 tool 75.036 MPa and minimum stress for 3 tool 8.337 MPa shown in fig no.3, maximum tool deformation is 0.294408mm shown in fig no.4.

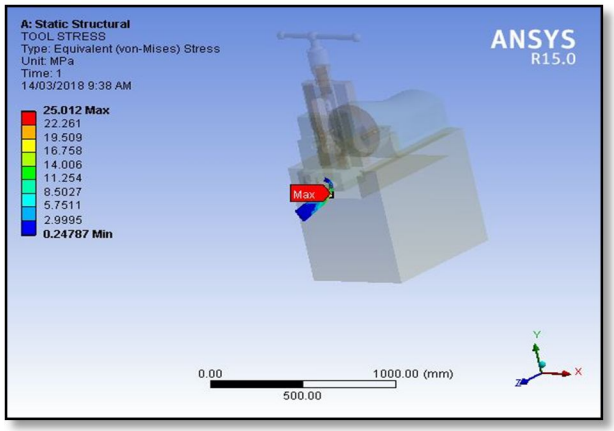

Fig. 6 Tool stresses

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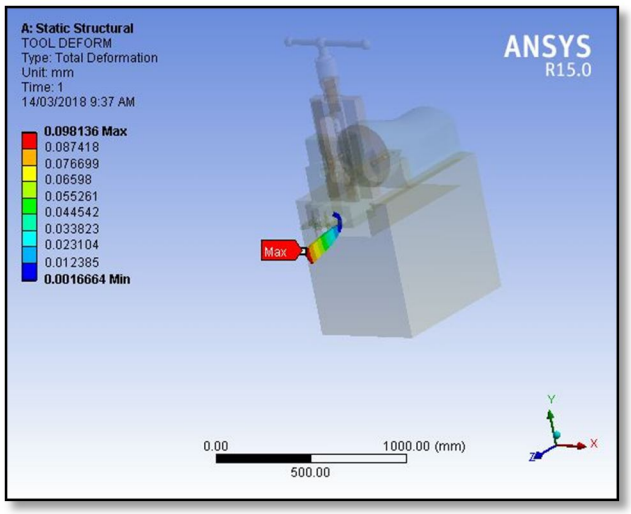

Fig. 7 Total deformation

fig 5 shows tool stresses acts on tools of shaper machine, tool stress developed for three tools that is maximum stress is 3*25.012=75.036 MPa and minimum stress is 3*0.24787=0.74361MPa and fig 6 shows total deformation that is maximum deformation is 3*0.98136=2.9440mm and minimum deformation is 3*0.0016664=4.992*10^{-3} mm

Sr.no.	Maximum	Minimum
Equivalent stress	75.036 MPa	8.337 MPa
Deformation	0.294408 mm	0
Tool stresses	75.036 MPa	0.74361MPa
Total deformation	2.9440 mm	4.992*10^{-3} mm

Table 1: Calculated result

IV. CONCLUSION

We the modification of shaper machine with replacement of tool holder of traditional shaper machine and design of model is done on solid works software and stresses and deformation of tool is calculated on ANSYS software and we found that stresses on single point cutting tool of modified shaper machine with replacement of tool holder attachment is within limit.

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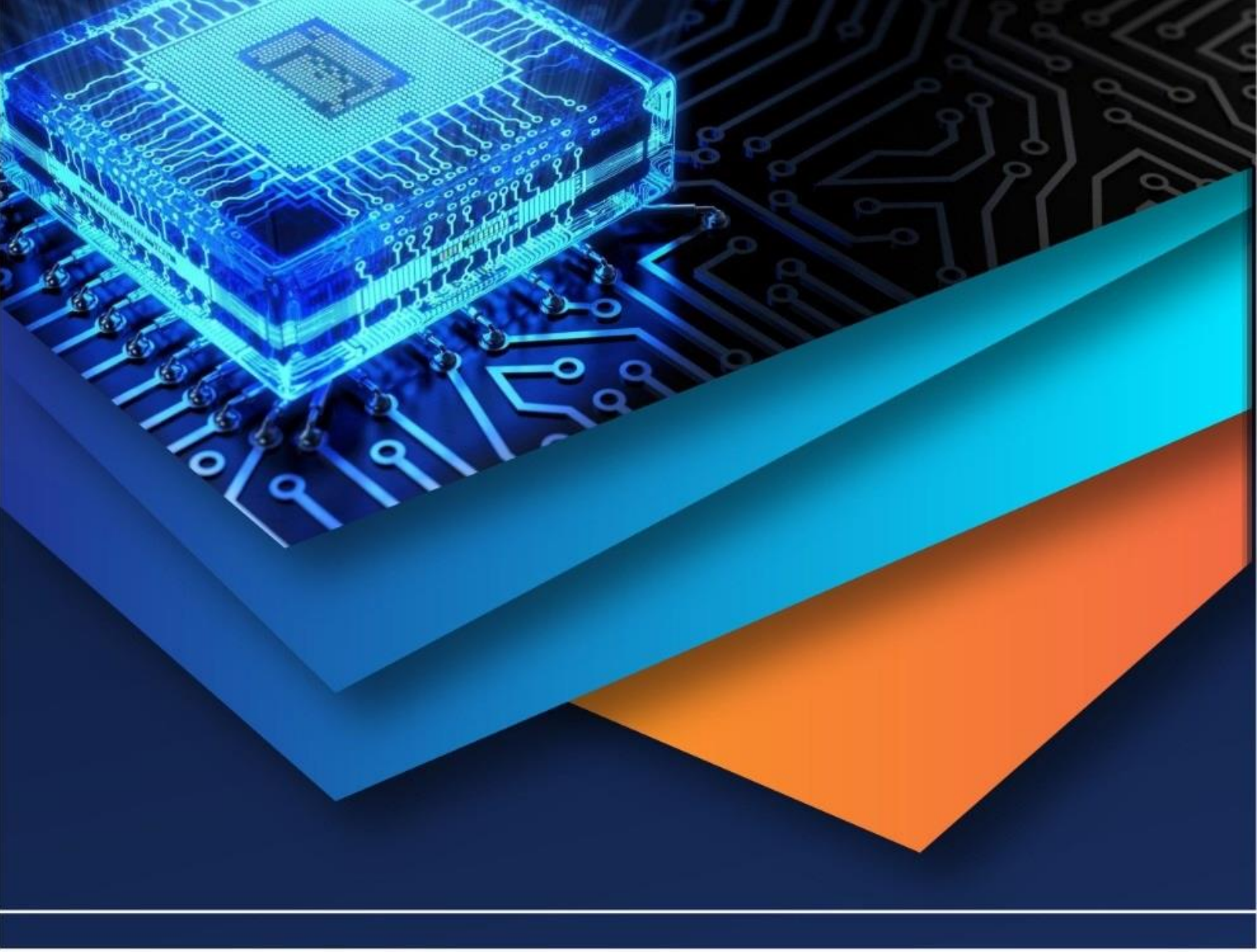

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